

Slow-Light-Enhanced Spectral Interferometers, Phase I

Completed Technology Project (2015 - 2015)



Project Introduction

We propose a research program aimed at developing spectral interferometers with dramatically enhanced performance. A key aspect of our approach is to place a highly dispersive (slow-light) material into one arm of a two-path, Mach Zehnder interferometer (MZI). Theoretical analysis shows that the spectral resolution under these circumstances can be enhanced by a factor as large as the group index of the slow-light material being used. Slow-light interferometers can produce dramatic increases in the resolution of a spectrometer or they can permit much smaller physical dimensions than standard spectrometers without any degradation of resolution. In the present program, we will undertake to develop spectrometers that can be employed under practical conditions and especially those of interest to NASA. We propose three related approaches to the design of enhanced spectrometers and will perform conceptual studies to quantify the relative merits of these approaches. This will allow future work to further develop the most promising design(s). The three approaches: 1.) A hybrid interferometer: a Fabry-Perot (FP) interferometer will be placed within a MZ interferometer. The transfer characteristics of the FP mimic those of a slow-light material. This design can achieve the same sort of enhancement of sensitivity as that of a true slow-light medium placed inside the MZI. 2.) Our second approach makes use of a similar analogy, but on a much smaller distance scale. This approach entails the fabrication of wavelength-scale defect resonators in an otherwise perfect photonic crystal (PhC). The design employs a sequence of such resonators each with a slightly different resonance wavelength. 3.) Our third approach is to fabricate mm-scale interferometers using nano fabrication on silicon. The slow light medium is a PhC waveguide formed by a line defect in a silicon PhC structure. We will couple these structures to waveguides in an interferometer configuration.



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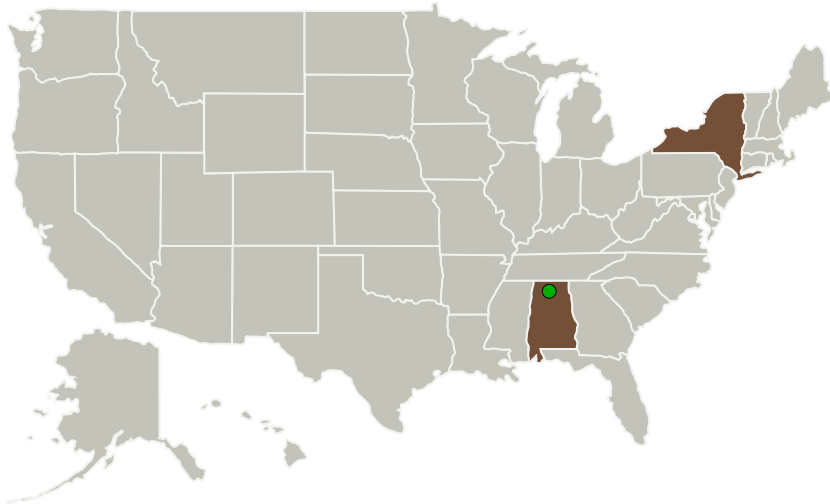
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
KBN Optics, LLC	Lead Organization	Industry	Pittsford, New York
● Marshall Space Flight Center (MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations

Alabama	New York
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Project Transitions

**June 2015:** Project Start**December 2015:** Closed out**Closeout Documentation:**

- Final Summary Chart(<https://techport.nasa.gov/file/139463>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

KBN Optics, LLC

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

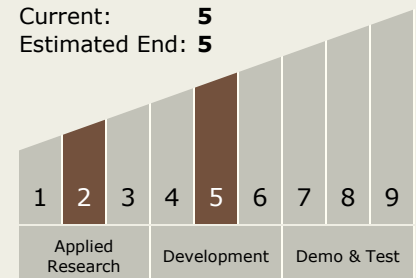
Carlos Torrez

Principal Investigator:

Omar S Magana-loaiza

Technology Maturity (TRL)

Start: 2
 Current: 5
 Estimated End: 5

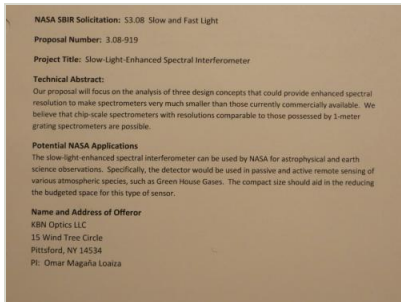


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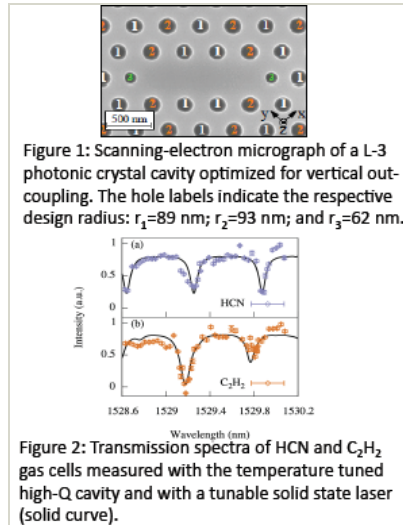


Images



Briefing Chart

Slow-Light-Enhanced Spectral Interferometers Briefing Chart
(<https://techport.nasa.gov/image/129615>)



Final Summary Chart Image

Slow-Light-Enhanced Spectral Interferometers, Phase I Project Image
(<https://techport.nasa.gov/image/126948>)

Technology Areas

Primary:

- TX08 Sensors and Instruments
 - └ TX08.1 Remote Sensing Instruments/Sensors
 - └ TX08.1.3 Optical Components

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System